Chapter 12
FIELD WORK

Introduction

Field work is always needed to provide the accurate base data for plan development. Surveys are compiled from several data sources including maps and land survey descriptions. The primary source for the designer is topographic ground survey. Field work also includes geotechnical investigations and design team field checks.

Other techniques of acquiring information about the project site involve aerial survey, aerial photography, photogrammetric mapping and subsurface investigations. These techniques are briefly described in this chapter, the emphasis being on field surveys obtained by conventional field methods.

The Survey Manual adopted by the NHDOT outlines procedures to be used by the Survey Section of the Bureau of Highway Design. The designer should have a general knowledge of its contents to better understand the practical work of field surveying.

Field Survey

Responsibility

The Chief of Design Services is in charge of a number of Survey Area Supervisors who in turn supervise a number of field survey crews.

The Chief of Design Services is directly responsible for the work of all survey crews. All requests for survey work must be directed to the Chief of Design Services and be authorized by the Section Head.

Survey work is expensive and time consuming. It is the responsibility of the highway (or bridge) designer to limit the requested survey information to that which is necessary to properly complete the design.

Base Data

Base data may include the following:

- Photogrammetric mapping tied to the State Plane Coordinate System,
- Aerial photographs and/or old project plans indicating the survey requirements,
- U. S. Geological Survey Quadrangle sheets
- Traverse lines tied to the State Plane Coordinate System,
- Verbal and written instructions

- Major property line information on plats or subdivision plans, and Town or City utility plans showing manhole locations, hydrant locations, and other visible features.

Horizontal Control

The New Hampshire State Plane Coordinate System of 1983 is utilized on all NHDOT projects. The advantages of using the State Plane Coordinate System are:

- All control surveys are on a single datum, and thus the relationship of one survey to others is established.
- All subsequent surveys can originate and close at stations of known position and reliability. Therefore, the reliability of the new survey can be easily determined and adjusted, if necessary.
- With GPS technology, points can be readily reestablished if Geodetic monuments are unavailable.
- Route surveys can be started at various points along the route with assurance that the survey sections will "fit."

The datum must be noted on all plans.

Vertical Control

Elevations of all Geodetic Monuments and the subsequent traverse points are relative to National Geodetic Vertical Datum of 1929 (NGVD29) or to the North American Vertical Datum of 1988 (NAVD88). The datum must be noted on all plans.

Note: For horizontal and vertical accuracy standards for the Survey Section, see the NHDOT Survey Manual.

Preliminary Survey

Preliminary surveys are defined as any survey work performed prior to advertising the project for construction contract bids. Surveys after advertising the project for bids are defined as construction surveys. Surveys in connection with final audit are also made to determine final quantities of certain pay items and to show the as-built location of the improvements made as part of the project.

Preliminary surveys include primary traverse and complete 3 dimensional topographic coverage of the project area. Particular attention must be given to all details underground, on the surface, or overhead, which may in any way affect the location of the proposed improvements.

Prior to entry onto any private property, Right-to-Enter letters are sent Registered Mail to all property owners within the project area. These property owners will be given ten (10) working days to respond to these letters once they have been sent from NHDOT Headquarters.

The purpose of the preliminary survey is to facilitate the preparation of preliminary plans. When the project scope is fully established, the preliminary survey can be a complete contract plans survey.

Construction Plans Survey

When information from old plans is either outdated or is insufficient to provide the necessary coverage, a complete new survey is requested by the Preliminary Design section, as required.

With the advent of computer aided design and drafting(CAD/D) and Total Station/Data Recorder surveying technology, the need to return to the project area is less likely than in the past. The preliminary survey covers a wide area and includes river grids, drainage outfalls and channels, wetland identification and information around structures to be used for quantity calculations. Typically the survey crew is not required to return to the project area until the proposed construction line layout is requested for geotechnical investigation.

Profiles, cross sections and river grids are all produced electronically in the computer based on the surveyed information. If any alignment changes are necessary, adjustments are made using the CAD/D system, and new profiles, cross sections and grids are produced. Plan Preparation Staff are responsible for field reviews to verify the accuracy of the preliminary survey. If there are any inconsistencies, the survey area supervisor is contacted to resolve the issue(s).

Computations

The Survey Section is responsible for computing the closure of horizontal traverses and adjusting bench circuits before turning them over to the design teams. Computations and adjustments are made by computer. The original computations are retained in CAD/D for use throughout the duration of the project.

Plotting

Topography is plotted by the Plan Prep group of Preliminary Design using information from survey data recorders and field books. The designer should take full advantage of the CAD/D capabilities in plotting vertical alignment and cross sections.

Field books will be a guide for Plan Prep to produce an accurate computer ground model. Questions regarding the information to be shown should be resolved before proceeding with plotting.

Field books should indicate the reference traverse used for the topographic locations. All traverse points are normally shown on the plan and the designer must not confuse the traverse lines when plotting topography. The Survey Section will make every effort to number the traverse points so as not to duplicate point numbers.

Standard graphic symbols and standard drafting practices are used to provide consistency in the preparation of plans. Standard abbreviations and symbols used in field survey books are illustrated in the Survey Manual.

Other Field Information

Land Boundaries

Land boundary markers may have legal significance as well as historical significance. Both considerations should be recognized. Surveyors are instructed to record the markings on monuments and designers must be aware that their plans should show the location accurately. Policy decisions concerning reestablishing monuments or dealing with historical markers will be made by the Highway Design Administrator.

Legal

Boundary markers established by public surveyors must not be moved without authority of the NHDOT. Surveyors of the NHDOT locate boundary markers and reference them for later re-establishment if necessary (RSA 572.25). Government bench marks, triangulation monuments or officially set land-lines of public surveys must be referenced or replaced and the responsible authority should be notified.

Historical

Old, well-established landmarks may have historical significance and must be identified as a potential environmental consideration. The marker may be a granite survey bound, stone, heavy iron stake or historic tree. The historical society for the project area should be contacted early and surveyors should be alerted if there are any known historical landmarks within the project area.

Bridge Sites

Information at Bridge site(s) or for major drainage hydrographic surveys are normally requested by the Bureau of Bridge Design. Waterway openings at bridges as well as major drainage structures are always given special consideration by the survey crews.

High-Water Marks

Evidence of debris or wash is noted by the survey crew and, where warranted, nearby property owners are contacted to obtain frequency information. Many times, the reported frequency will coincide with major storms of record which is useful information for the drainage designer. Significant erosion or washouts are always reported.

Boring Locations

The location of subsurface explorations (test borings and test pits), both proposed and actual, are recorded in the field notes. Although the designer will refer to the recommendations in the Geotechnical Report (prepared by Materials and Research), the designer may need to refer to the field notes occasionally to check ground elevations to compare with the subsurface

exploration logs. The subsurface exploration records are loose-leaf field notes kept in survey files. A duplicate is filed with the Bureau of Materials and Research.

Aerial Survey

Aerial surveys performed by others for use by the NHDOT consist of enlarged photographs or photogrammetric mapping to be used for preliminary design purposes.

There are a number of combinations of aerial photographs and maps which can be used by the designer. In all cases, there are limitations to the accuracy that should be recognized. In particular, enlarged uncontrolled photographs are less distorted in the center, however, all original distortion is magnified. The enlargement sometimes gives the designer scale confidence which is not justified.

There are however, significant advantages to using aerial enlargements, especially for preliminary design. For example, the area of interest can be determined with reasonable accuracy from photographs and this information (embellished) can be used as a location map for presentations or as a mark-up to request more accurate ground survey.

Accuracy

When dealing with photogrammetrically-prepared plannimetric or topographic maps, the designer should be aware of the accuracy to be expected. If more accurate data is needed, a ground survey should be requested to obtain the information. Accuracy in photogrammetric mapping is affected by many conditions but, for the designer/user, the following accuracy should be expected:

Contours	90 percent of solid-line contours will be 1/2 a contour interval from true elevation. 10 percent may not be in error more than one contour interval.
Spot Elevations	90 percent within 1/4 contour interval, 10 percent within 1/2 contour interval.
Coordinate Grids	All grid coordinates will be within 0.25 mm of true value.
Planimetry	90 percent of all well-defined objects(on photographs) will be positioned to 0.625 mm of their true position. No feature will be misplaced by more than 1.25 mm from true coordinates position.

Subsurface Investigation

Underground information at best is the educated assumption of trained geologists or engineers based upon the state-of-the-art technology. The designer should accept the findings with the understanding that the information is the best obtainable given the obvious limitations.

Underground utility information with visible surface evidence should be accepted but critical locations may need to be uncovered (or potholed) by the utility company and positively located by the survey crew.

Most underground survey work is concerned with soil or rock type and the effort needed for positive identification varies with the anticipated problems and the cost of exploration. Two general categories of investigations are considered next.

Reconnaissance

As explained briefly in Chapter 2, Project Development, reconnaissance geotechnical surveys are performed by personnel from Materials and Research. This type of visual inspection is sometimes supplemented by selected subsurface exploration. There are occasions when muck or bedrock locations are identified by the designer and should be discussed with the Senior Supervisor.

If subsurface exploration is required, it is normally requested during the Preliminary Design stage. The latest available plan, profile and cross sections are forwarded with this request. The designer should always question suspicious soil conditions.

Subsurface Exploration

Subsurface exploration for highway construction is accomplished with soil augers, rock cores, auger drill rigs and backhoes. The type of exploration to be performed is determined by Materials and Research after evaluating the geological strata and project characteristics.

Rock coring or auger drilling is used for bridge foundation exploration but, again, the method of exploration is determined by Materials and Research.

Note: Any request for subsurface exploration must be coordinated with the Chief of Design Services and Dig Safe to prevent situations due to the presence of underground utilities. Standard practice is to prepare a plan to accompany a letter from the Chief of Design Services to Materials and Research listing the utilities known to have facilities in the area.